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Kim

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(54) **RUPTURE DISK AND GAS INSULATED SWITCHGEAR HAVING THE SAME**

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CPC **F16K 13/04** (2013.01); **F16K 17/1613**
(2013.01); **Y10T 137/1692** (2015.04)

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Y10T 137/1699; Y10T 137/1692; Y10T
137/1752; Y10T 137/1759; F16K 13/04;
F16K 17/1613
USPC 137/68.27, 68.25, 68.21, 68.19, 68.28,
137/68.29
See application file for complete search history.

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Primary Examiner — Craig Schneider

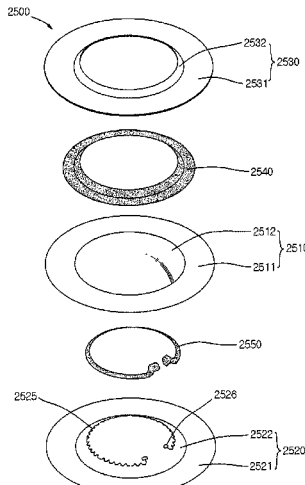
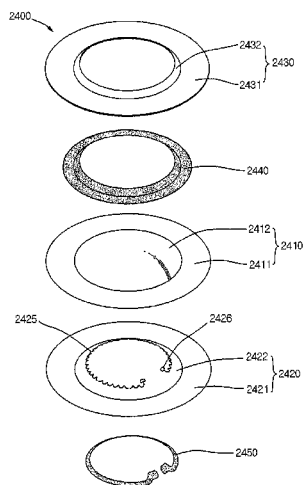
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(57) **ABSTRACT**

A rupture disk for a gas insulated switchgear which includes a thin dome plate that includes a first flange portion and a first dome-shaped portion formed in a dome shape, at the center of the first flange portion; and a rupture guide plate which includes a second flange portion, laminated on the first flange portion, and a second dome-shaped portion has a plurality of slots formed therein to define a rupture shape so that a part of the first dome-shaped portion is ruptured, in a predetermined shape, when an internal pressure increases. End portions of slots, disposed at both edges among the plurality of slots, are provided with rupture restriction openings, respectively, to configure a hinge portion of the second dome-shaped portion.

13 Claims, 16 Drawing Sheets



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FIG. 1

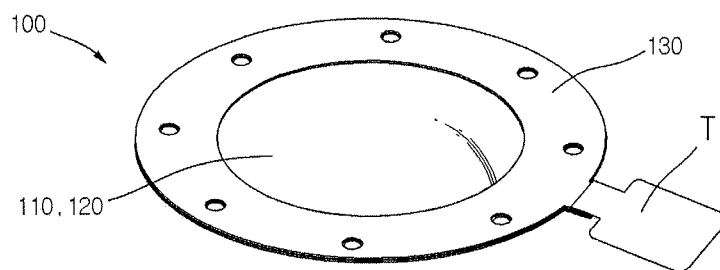


FIG. 2

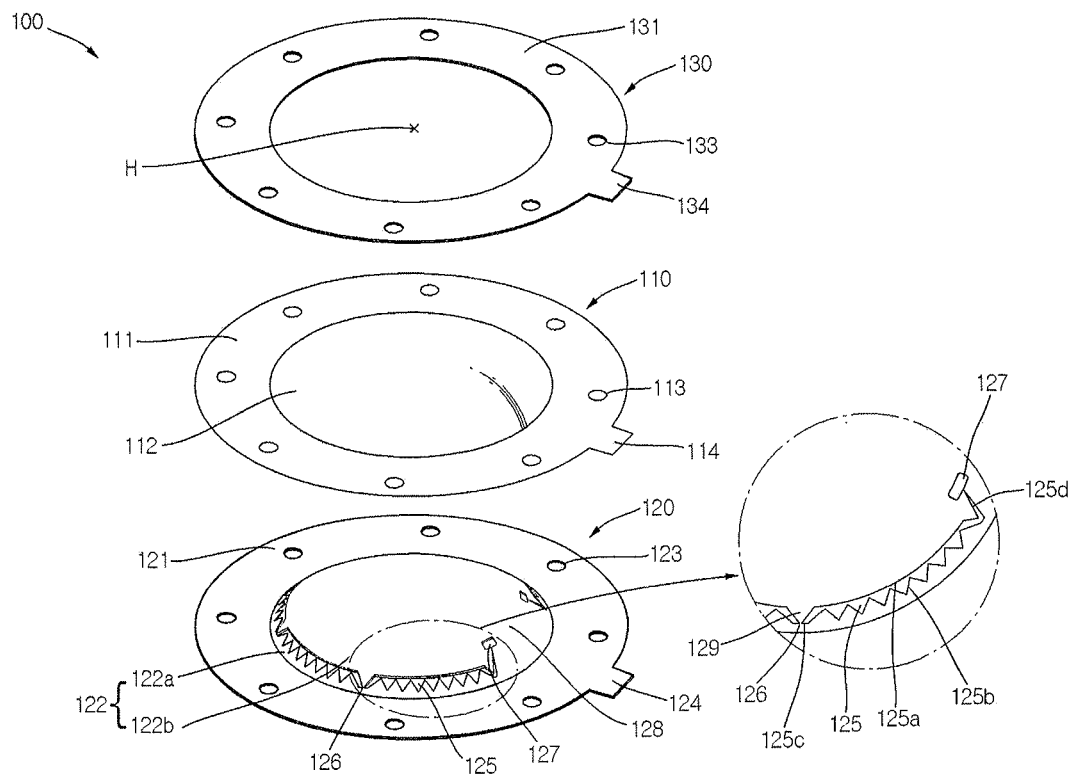


FIG. 3

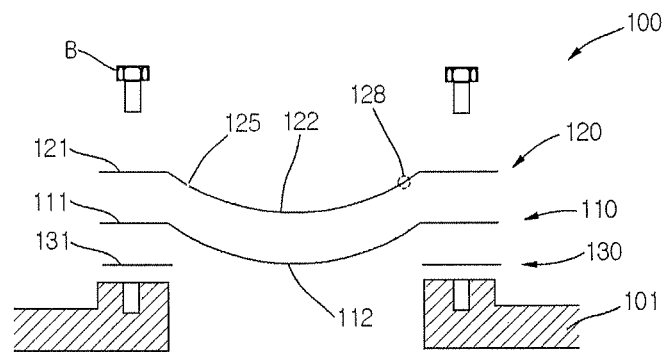


FIG. 4

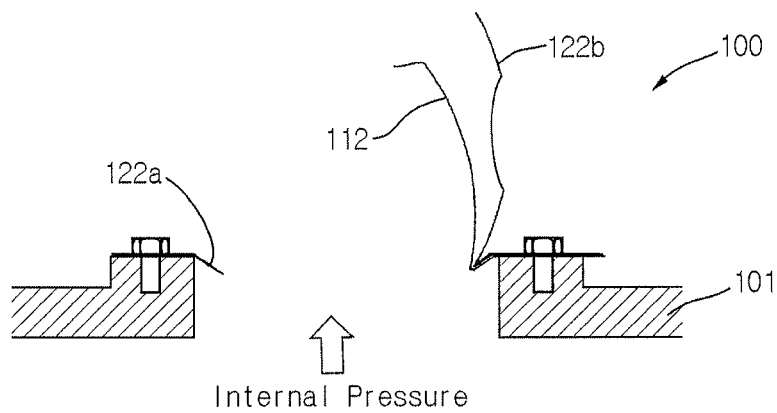


FIG. 5

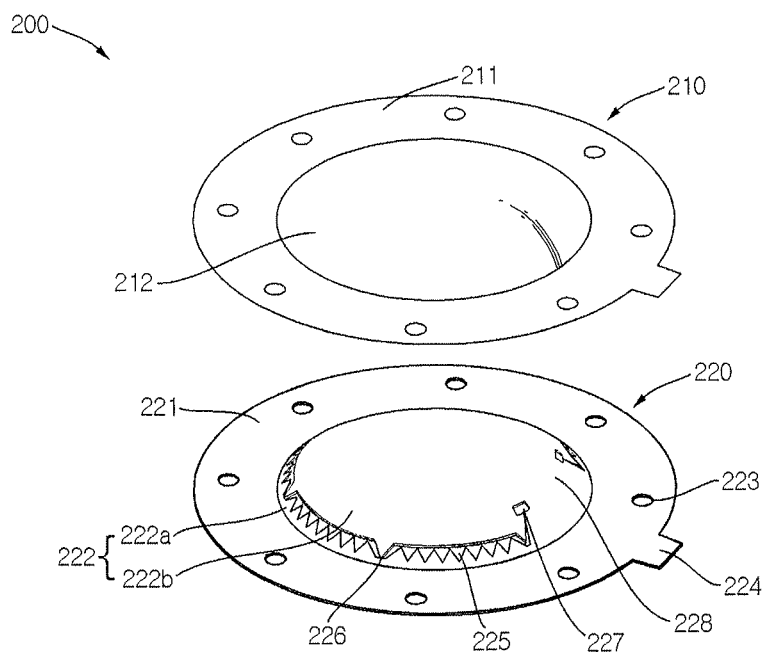


FIG. 6

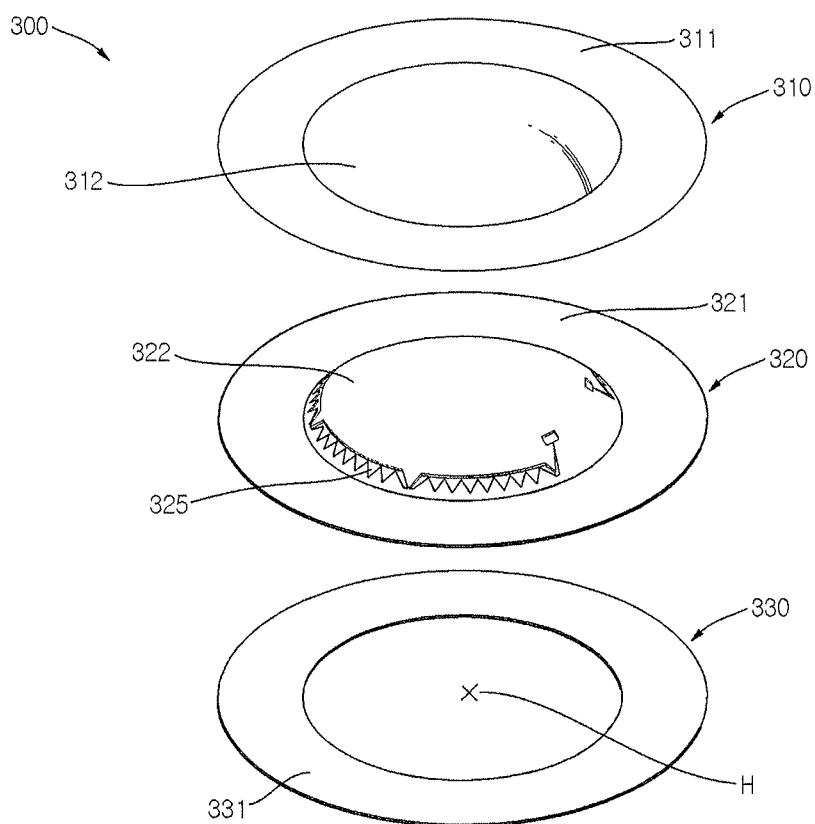


FIG. 7

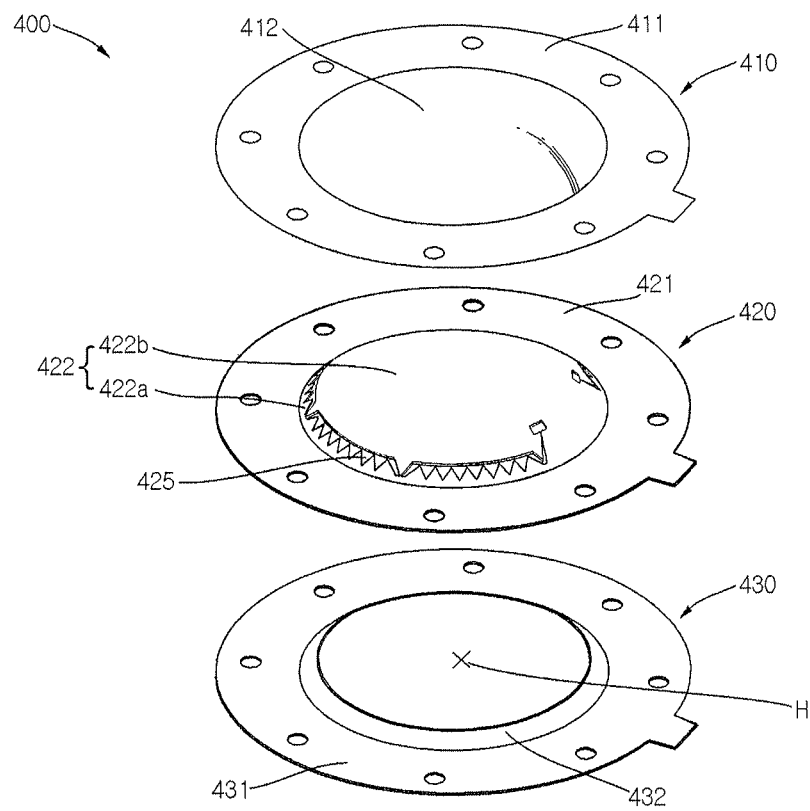


FIG. 8

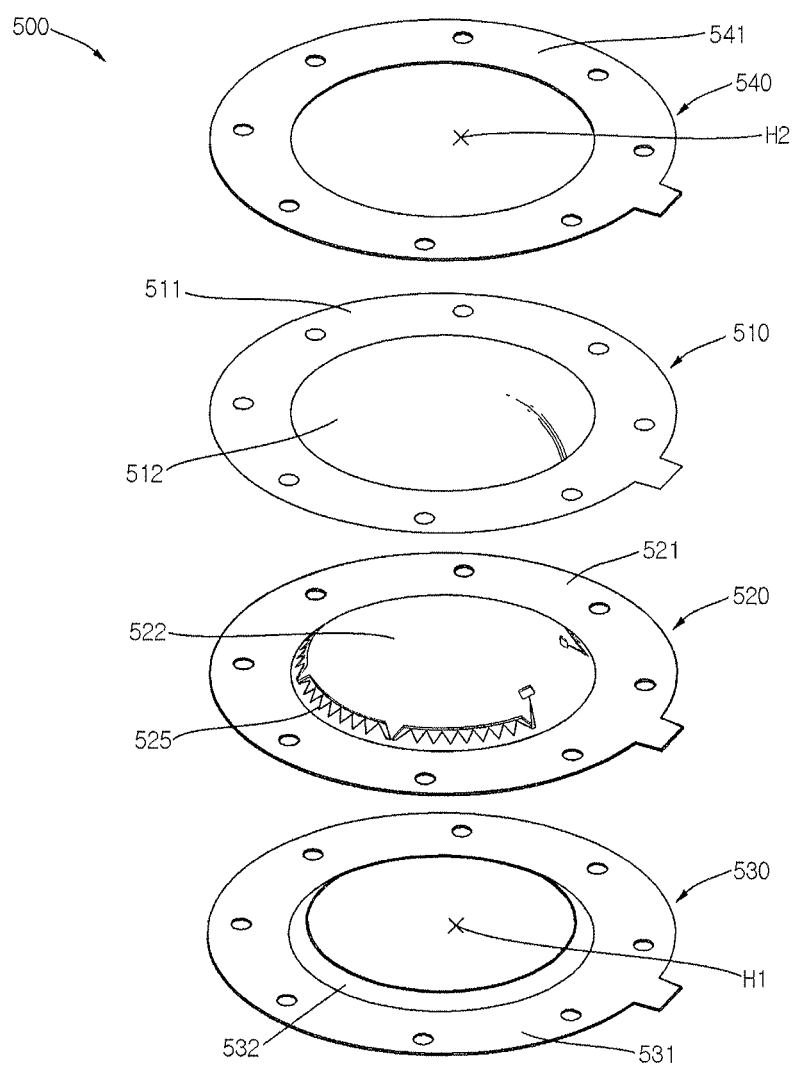


FIG. 9

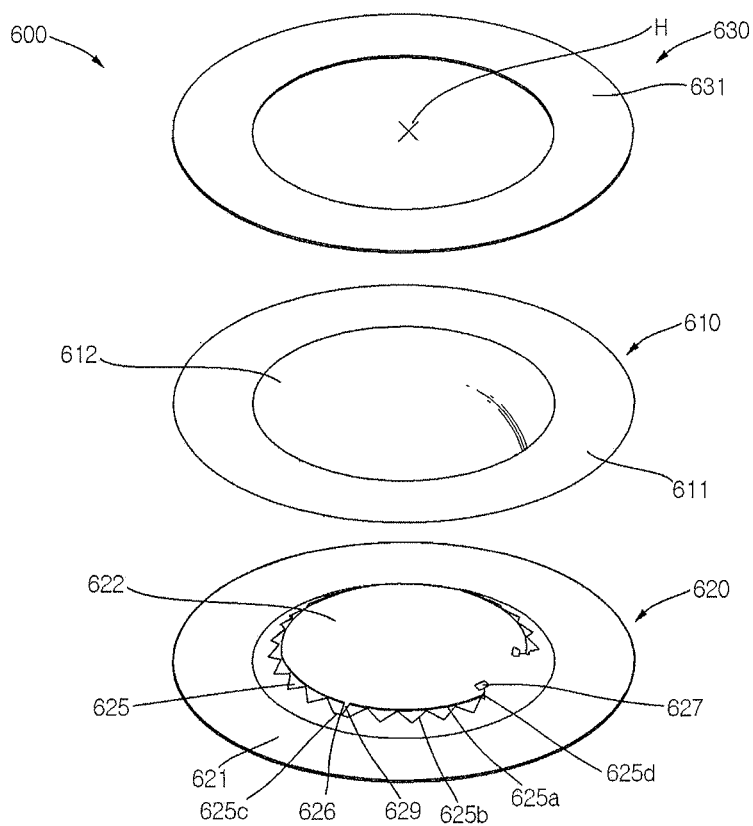


FIG. 10

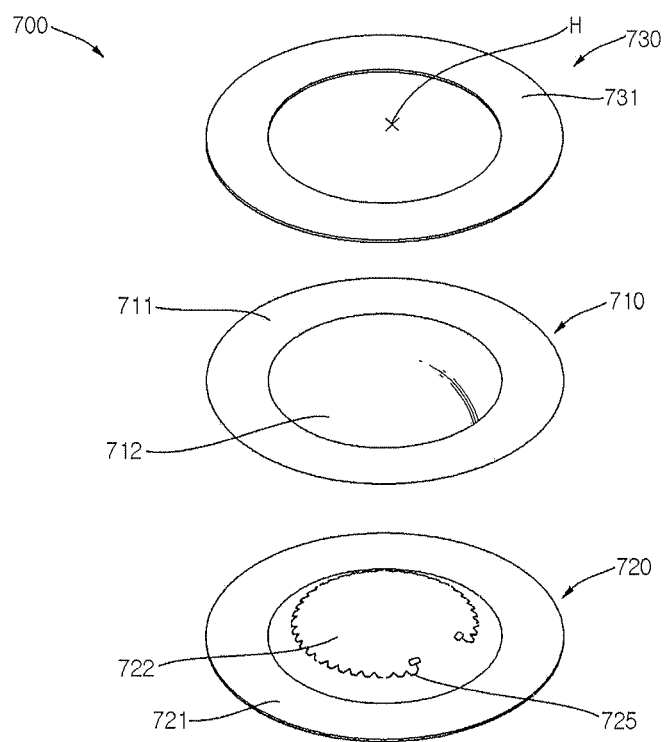


FIG. 12

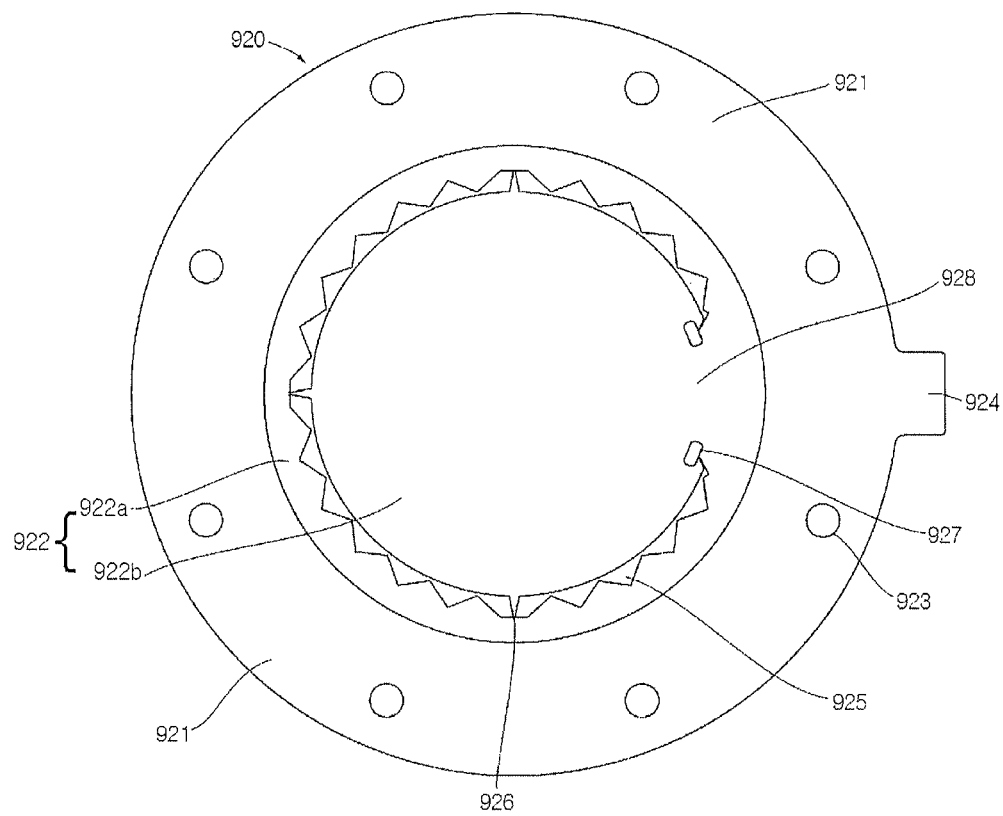


FIG. 13

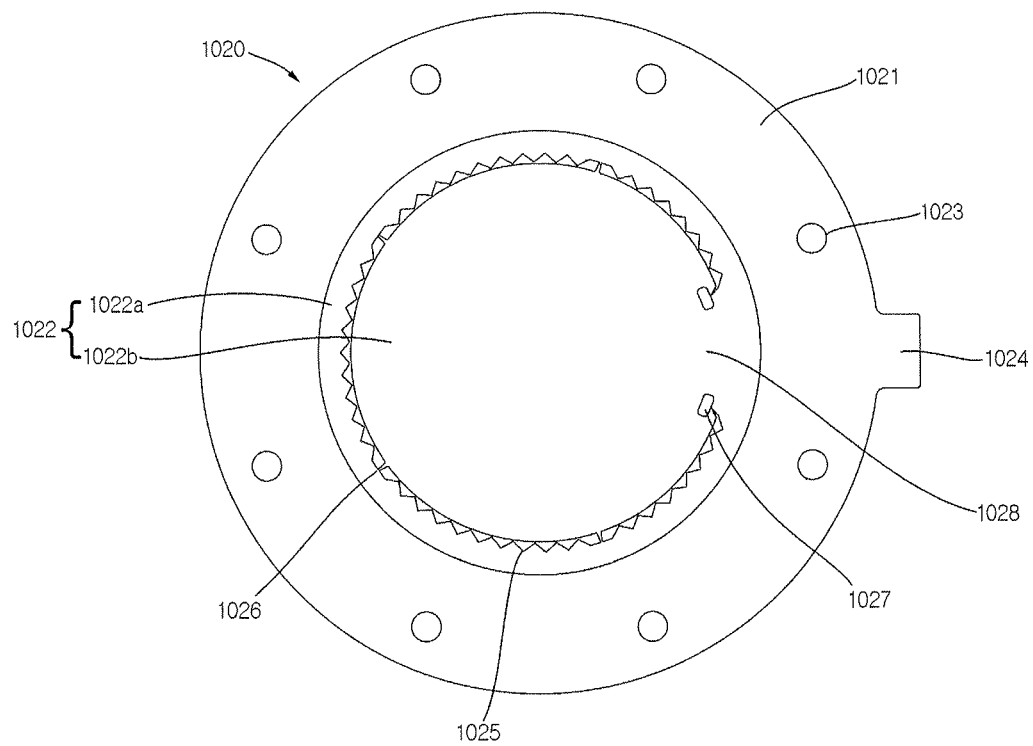


FIG. 14 (a)

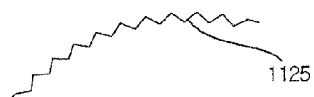


FIG. 14 (b)

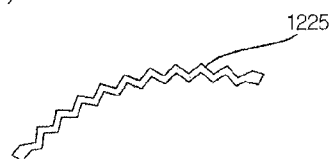


FIG. 14 (c)



FIG. 14(d)

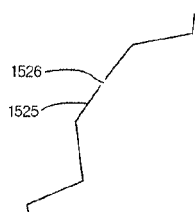
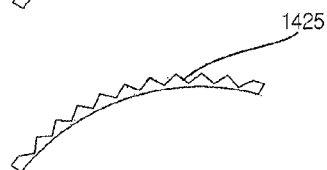


FIG. 15 (a)

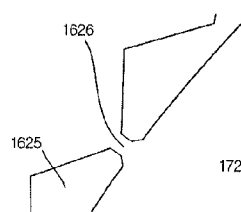


FIG. 15 (b)

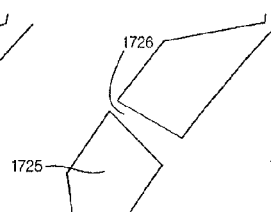


FIG. 15(c)

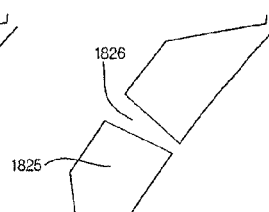


FIG. 15(d)

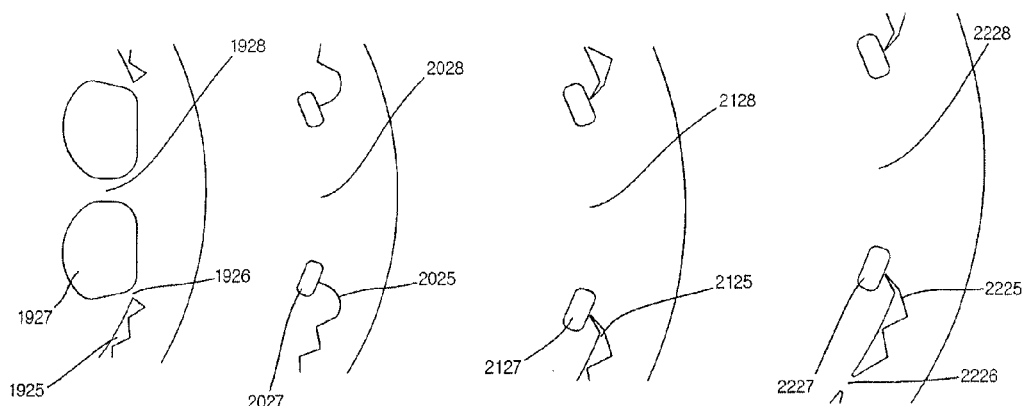


FIG. 16(a) FIG. 16(b)

FIG. 16(c)

FIG. 16(d)

FIG. 17

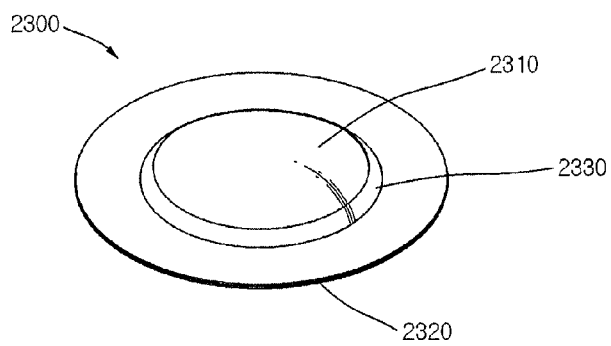


FIG. 18

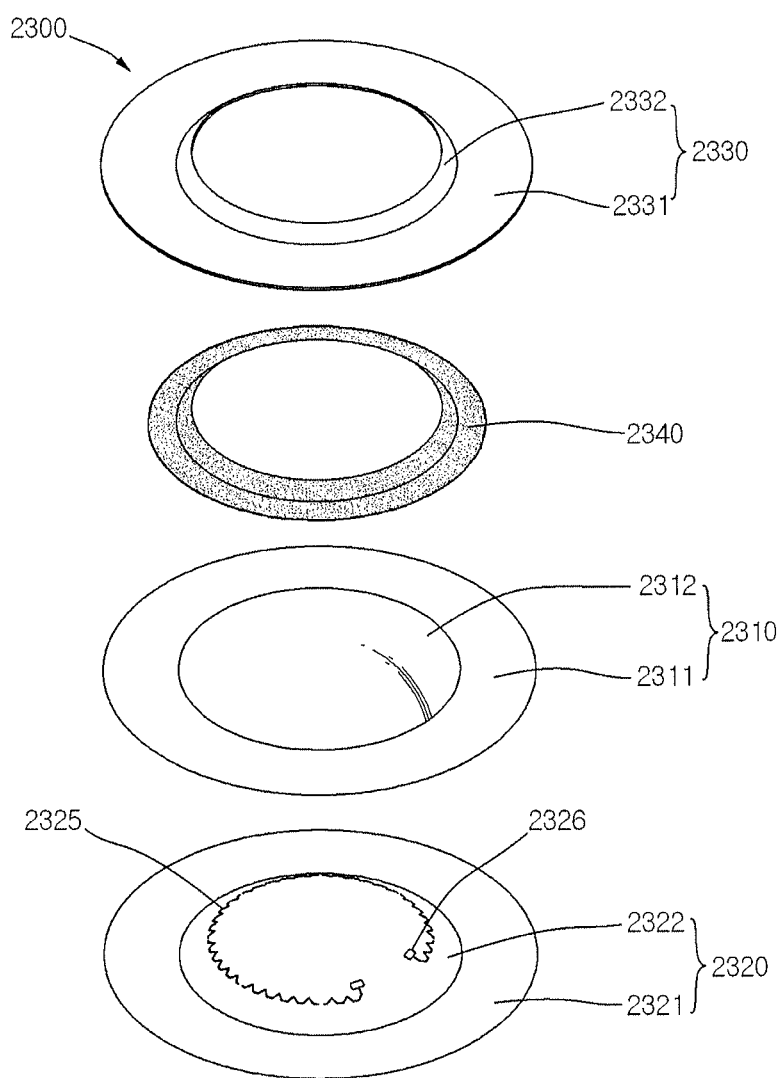


FIG. 19

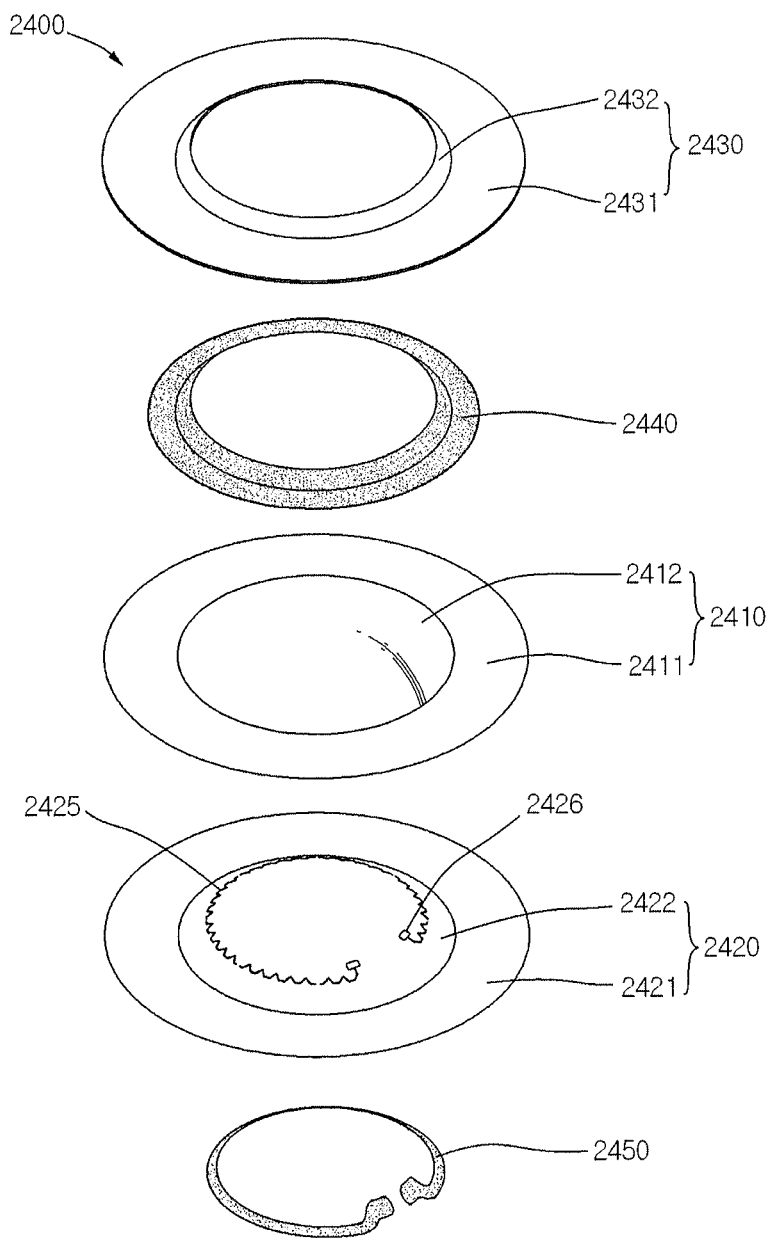
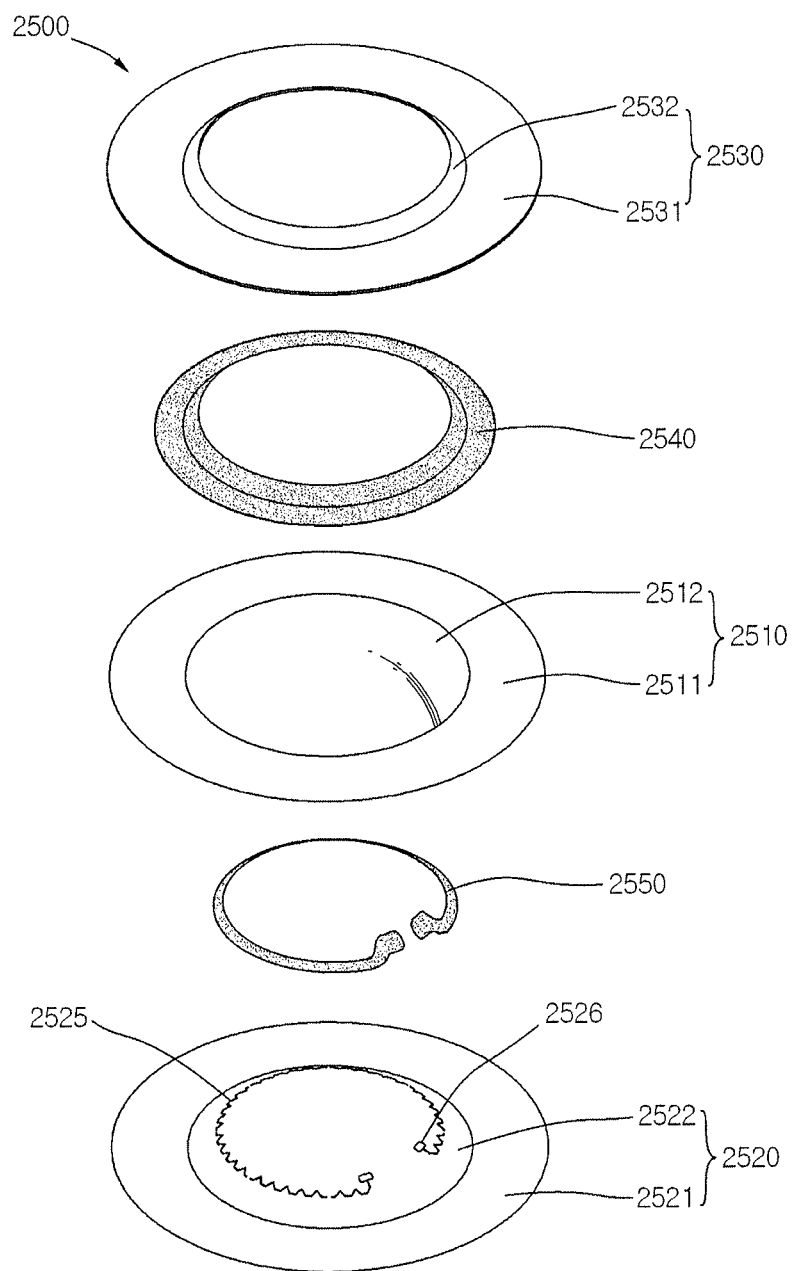


FIG. 20



RUPTURE DISK AND GAS INSULATED SWITCHGEAR HAVING THE SAME

CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit of Korean Patent Application No. 10-2012-0077055, filed on Jul. 16, 2012, and Korean Patent Application No. 10-2012-0095946, filed on Aug. 30, 2012, entitled "Rupture Disk and Gas Insulated Switchgear Having the Same", which is hereby incorporated by reference in its entirety into this application.

BACKGROUND

1. Field

The present invention relates to a rupture disk capable of minimizing damage to a system by allowing insulated gas to be discharged in advance at the time of an increase in an internal pressure, and a gas insulated switchgear having the same.

2. Description of the Related Art

In a gas insulated switchgear (GIS), which is one of the circuit breakers in various electric circuits, GIS is filled by gas as an insulator in the circuit breaker. A sulphur hexafluoride (SF_6) gas that has been spotlighted as an insulated gas has an insulation effect three times higher than that of air. This insulation effect increases when a pressure is applied to the sulphur hexafluoride (SF_6) gas. Due to these electrical characteristics of the SF_6 gas, the circuit breaker may obtain a good insulation performance even in a space smaller than that of an existing case, it has been mainly used in the gas insulated switchgear accordingly.

When the gas insulated switchgear in which the SF_6 gas is filled is maintained under a predetermined pressure, a problem does not occur. However, in the gas insulated switchgear in which the SF_6 gas is filled, when a short circuit occurs due to an electrical accident, energy suddenly increases to raise a temperature, an internal pressure suddenly increases accordingly and a pressure container explodes. In this case, a recovery time increases, which may cause economical loss to astronomically increase and damage to the environment and human life. Therefore, it is important to prevent explosion of an apparatus in advance.

In order to solve the sudden increase in the pressure in the gas insulated switchgear, a spring type safety valve has been suggested. However, in the spring type safety valve, it is often difficult to solve an unexpected sudden increase in an accidental pressure rise. Further, in order to solve this problem, a scheme of using a rupture disk has also been suggested. However, in this scheme, there is a disadvantage in that fragments are blocked, such that a pressure does not smoothly decrease or a human is injured by the fragments.

SUMMARY

An object of the present invention is to provide a rupture disk discharging an excess pressure to surrounding place when a pressure of a safety limitation pressure or an appropriate pressure or more is applied thereto so as to cope with a sudden increase in a pressure due to an unexpected fault of an inner portion of a gas insulated switchgear to minimize damage to a device and prevent a large accident or damage to a human in advance, and a gas insulated switchgear having the same.

Another object of the present invention is to provide a rupture disk closely adhered to a portion at which discharging

of a large amount of insulated gas is instantaneously required in a gas insulated switched gear or a portion at which damage is not generated at the time of discharging the insulated gas in the gas insulated switched gear to thereby be formed integrally with the above-mentioned portion and safely ruptured in advance at the time of a sudden increase in a pressure to prevent damage to the entire pressure container, and a gas insulated switchgear having the same.

According to an exemplary embodiment of the present invention, there is provided a rupture disk for a gas insulated switchgear, including: a thin dome plate including a first flange portion and a first dome-shaped portion formed in a dome shape at the center of the first flange portion; and a rupture guide plate including a second flange portion laminated on the first flange portion and a second dome-shaped portion having a plurality of slots formed to define a rupture shape so that a part of the first dome-shaped portion is ruptured in a predetermined shape when an internal pressure increases, wherein end portions of slots disposed at both edges among the plurality of slots are provided with rupture restriction openings, respectively, to configure a hinge portion of the second dome-shaped portion.

Each of the plurality of slots may include an arc inner profile and a sawtooth outer profile, the sawtooth outer profile may include inner vortexes and outer vortexes that are alternately arranged, and the slot and another slot adjacent thereto may be connected to each other by a rupture bridge at an outer vortex of the sawtooth outer profile.

The rupture disk may further include a support plate including a third flange portion laminated on the first flange portion, wherein the third flange portion has an opening formed at a center portion thereof in order to provide a space in which the first dome-shaped portion is to be installed.

The rupture disk may further include a first support plate including a third flange portion laminated on the second flange portion, wherein the third flange portion has an open type support formed at a center portion thereof in order to support an edge portion of the first dome-shaped portion.

The rupture disk may further include a second support plate including a fourth flange portion laminated on the first flange portion, wherein the fourth flange portion has an opening formed at a center portion thereof in order to provide a space in which the first dome-shaped portion is to be installed.

The thin dome plate may further include a first protrusion portion protruding at at least one portion of the first flange portion in a radial direction, and the rupture guide plate may further include a second protrusion portion protruding at a position corresponding to that of the first protrusion portion in the radial direction.

Each of the first flange portion and the second flange portion may be provided with a plurality of fastening holes through which fastening bolts pass and which are formed in a circumferential direction.

The first flange portion and the second flange portion may be pressure-welded and coupled to each other at a plurality of positions in a circumferential direction.

Each of the plurality of slots may include an inner profile and an outer profile, wherein the inner profile includes arc or oval patterns that are arranged at predetermined interval, and the outer profile includes sawtooth patterns that are repeatedly arranged.

The plurality of slots may be formed in a sawtooth line shape, and adjacent slots among the plurality of slots may be formed to have a predetermined interval therebetween to configure a rupture bridge.

The rupture restriction opening and the slot may be connected to each other by a connection slot.

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According to another exemplary embodiment of the present invention, there is provided a rupture disk for a gas insulated switchgear, including: a thin dome plate including a first flange portion and a first dome-shaped portion formed in a dome shape at the center of the first flange portion; a rupture guide plate laminated inside the first flange portion and the first dome-shaped portion and including a second flange portion laminated on the first flange portion and a second dome-shaped portion having a plurality of slots formed to define a rupture shape so that a part of the first dome-shaped portion is ruptured in a predetermined shape when an internal pressure increases; and a thin protecting plate laminate outside the first flange portion and the first dome-shaped portion so as to protect the thin dome plate and including a third flange portion laminated on the first flange portion and an open dome-shaped protecting surface protecting an outer portion of the first dome-shaped portion.

The rupture disk may further include a flexible sealing layer disposed between the first flange portion and the third flange portion or between the first dome-shaped portion and the open dome-shaped protecting surface and formed so as to maintain air-tightness between the first flange portion and the third flange portion or between the first dome-shaped portion and the open dome-shaped protecting surface.

The flexible sealing layer may be made of a silicone resin or a silicone rubber.

According to still another exemplary embodiment of the present invention, there is provided a gas insulated switchgear including the rupture disk as described above.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing a state in which a rupture disk **100** according to a first exemplary embodiment of the present invention is assembled;

FIG. 2 is an exploded perspective view showing a laminated state of the rupture disk **100** of FIG. 1;

FIG. 3 is a lateral cross-sectional view for describing a state in which the rupture disk **100** of FIG. 1 is assembled to an object **101**;

FIG. 4 is a lateral cross-sectional view schematically showing a state in which the rupture disk **100** of FIG. 3 is applied with an internal pressure to thereby be ruptured;

FIG. 5 is an exploded perspective view of a rupture disk **200** according to a second exemplary embodiment of the present invention;

FIG. 6 is an exploded perspective view of a rupture disk **300** according to a third exemplary embodiment of the present invention;

FIG. 7 is an exploded perspective view of a rupture disk **400** according to a fourth exemplary embodiment of the present invention;

FIG. 8 is an exploded perspective view of a rupture disk **500** according to a fifth exemplary embodiment of the present invention;

FIG. 9 is an exploded perspective view of a rupture disk **600** according to a sixth exemplary embodiment of the present invention;

FIG. 10 is an exploded perspective view of a rupture disk **700** according to a seventh exemplary embodiment of the present invention;

FIG. 11 is a plan view showing one form of a rupture guide plate that may be used in the rupture disk according to the present invention;

FIG. 12 is a plan view showing another form of a rupture guide plate that may be used in the rupture disk according to the present invention;

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FIG. 13 is a plan view showing still another form of a rupture guide plate that may be used in the rupture disk according to the present invention;

FIGS. 14A to 14D are plan views showing various patterns of a slot that may be formed in the rupture guide plate according to the present invention;

FIGS. 15A to 15D are plan views showing various connection patterns between adjacent slots that may be formed in the rupture guide plate according to the present invention;

FIGS. 16A to 16D are plan views showing various patterns of a hinge portion that may be formed in the rupture guide plate according to the present invention;

FIG. 17 is a perspective view showing a state in which a rupture disk **2300** according to an eighth exemplary embodiment of the present invention is assembled;

FIG. 18 is an exploded perspective view showing a laminated state of the rupture disk **2300** of FIG. 17;

FIG. 19 is an exploded perspective view of a rupture disk **2400** according to a ninth exemplary embodiment of the present invention; and

FIG. 20 is an exploded perspective view of a rupture disk **2500** according to a tenth exemplary embodiment of the present invention.

DETAILED DESCRIPTION

Hereinafter, a rupture disk and a gas insulated switchgear according to exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings.

FIG. 1 is a perspective view showing a state in which a rupture disk **100** according to a first exemplary embodiment of the present invention is assembled; and FIG. 2 is an exploded perspective view showing a laminated state of the rupture disk **100** of FIG. 1.

As shown in FIGS. 1 and 2, the rupture disk **100** has a form in which a plurality of plates are laminated. More specifically, the rupture disk **100** includes a thin dome plate **110**, a rupture guide plate **120**, and a support plate **130**. These plates are mutually laminated and assembled to have an assembly form as shown in FIG. 1. The rupture disk **100** has a tap T attached to one side thereof in order to display various specifications of the rupture disk **100**. The assembled rupture disk **100** is formed in a dome shape in which a central portion thereof is convex and is assembled so that a convex dome portion is directed toward a container of a gas insulated switchgear.

The thin dome plate **110** is configured to maintain airtightness with respect to an insulated gas such as an SF₆ gas filled in the gas insulated switchgear in a predetermined pressure range and be ruptured at a pressure of a predetermined pressure or more. Referring to FIG. 2, the thin dome plate **110** has a first flange portion **111** and a first dome-shaped portion **112** formed in a dome shape at an inner side of the first flange portion **111**.

The first flange portion **111**, which is closely adhered to an opening surface of the gas insulated switchgear, is provided with a plurality of fastening holes **113** through which fastening bolts may pass and which are formed in a circumferential direction. The first dome-shaped portion **112**, which is installed to be depressed toward an inner portion of the gas insulated switchgear, may have a form in which it is depressed toward the inner portion of the gas insulated switch gear at the time of a normal operation and be deformed in a reverse direction when an internal pressure increases to protrude outwardly. The thin dome plate **110**, which is formed in a thin metal sheet form, may have various thicknesses according to a rupture capacity.

One side of the first flange portion **111** is provided with a first protrusion portion **114** protruding from the first flange portion **111**. The first protrusion portion **114**, which has a form in which it is formed integrally with an extended plane of the first flange portion **111**, provides a region to which a tag T capable of displaying a performance of a specification of the rupture disk **100** may be attached by spot welding.

The rupture guide plate **120**, which is disposed on a rear surface of the thin dome plate **110** in a relationship with the gas insulated switchgear, is generally formed in a shape corresponding to that of the thin dome plate **110**. More specifically, the rupture guide plate **120** also includes a second flange portion **121** laminated on the first flange portion **111** and a second dome-shaped portion **122** formed in a dome shape corresponding to that of the first dome-shaped portion **112**. The second dome-shaped portion **122** has slots **125** formed to define a rupture shape so that the first dome-shaped portion **122** may be ruptured in a predetermined shape at a limitation pressure in the case in which the internal pressure increases. The second dome-shaped portion **122** is divided into a support dome **122a** and a flap dome **122b** by the slots **125**. When the internal pressure is applied to the thin dome plate **110**, the flap dome **122b** provides a space in which the thin dome plate **100** may be ruptured and expanded, which being separated from the support dome **122a** and opened.

The second flange portion **121** is provided with a plurality of fastening holes **113** through which the fastening bolts may pass and is provided with a second protrusion portion **124** at a position corresponding to that of the first protrusion portion **114**, similar to the first flange portion **111**. The second protrusion portion **124**, which has a form in which it is formed integrally with an extended plane of the second flange portion **121**, is closely adhered to the first protrusion portion **114**.

Referring to an enlarged view of FIG. 2, the slot **125** of the rupture guide plate **120** has a form in which it includes an arc inner profile **125a** and a sawtooth outer profile **125b**. The sawtooth outer profile **125b** provides a sharp vortex so that the thin dome plate **110** to which the pressure is applied may be easily ruptured. The slot **125** generally has a form in which it includes a plurality of unit slots having an arc shape.

One unit slot is connected to another unit slot adjacent thereto by a rupture bridge **126**. The rupture bridge **126** becomes one parameter for determining a rupture pressure when the pressure is applied to the thin dome plate **110**. Therefore, a shape or a size of the rupture bridge may also be designed according to a set rupture pressure. Referring to an enlarged view of FIG. 2, the sawtooth outer profile **125b** includes inner vortexes and outer vortexes that are alternately arranged. The rupture bridge **126** between the unit slots is positioned at the outer vortex **125c** of the sawtooth outer profile **125b** rather than the inner vortex of the sawtooth outer profile **125b**. Therefore, the flap dome **122b** is formed in a generally circular shape by the arc inner profiles **125a**, but includes a triangular protrusion portion **129** in order to form the rupture bridge **126**.

The unit slots configuring the slot **125** are arranged at predetermined angle intervals in a circumferential direction, and two of the unit slots among them may be formed to have a distance therebetween larger than a distance therefrom to the rupture bridge **126** to configure a hinge portion **128** of the second dome-shaped portion **122**. End portions of the adjacent two unit slots defining the hinge portion **128** are provided with rupture restriction openings **127**, respectively. The rupture restriction open **127** prevents damage to the hinge portion **128** at the time of rupture of the rupture guide plate **120** and prevents the flap dome **122b** from being separated from the support dome **122a** at the time of the rupture of the rupture

guide plate **120**. A shape or a size of the rupture restriction opening **127** is another parameter for determining the rupture pressure or the rupture shape and is designed according to a set rupture pressure. The rupture guide plate **120** includes a connection slot **125d** so that the slot **125** and the rupture restriction opening **127** may be connected to each other. A shape of the connection slot **125d** may be still another parameter for detecting the rupture pressure and be designed according to a set rupture pressure.

The support plate **130** may be laminated on the thin dome plate **110** or the rupture guide plate **120**. In FIG. 2, the case in which the support plate **130** is laminated on the thin dome plate **110** is shown. Therefore, the support plate **130** is positioned between the thin dome plate **110** and the gas insulated switchgear and serves to maintain the air-tightness and support the thin dome plate **110**. The support plate **130** includes a third flange portion **131** laminated on the second flange portion **121**, wherein the third flange portion **131** has an opening H formed at the center thereof in order to provide a space in which the first dome-shaped portion **112** of the thin dome plate **110** is to be installed. The third flange portion **131** is provided with a plurality of fastening holes **133** through which the fastening bolts may pass and is provided with a third protrusion portion **134** at a position corresponding to those of the first protrusion portion **114** and the second protrusion portion **124**, similar to the first flange portion **111** and the second flange portion **121**. The third protrusion portion **134**, which has a form in which it is formed integrally with an extended plane of the third flange portion **131**, is closely adhered to the first protrusion portion **114** and the second protrusion portion **124**.

FIG. 3 is a lateral cross-sectional view for describing a state in which the rupture disk **100** of FIG. 1 is assembled to an object **101**; and FIG. 4 is a lateral cross-sectional view schematically showing a state in which the rupture disk **100** of FIG. 3 is applied with an internal pressure to thereby be ruptured.

The first flange portion **111** of the thin dome plate **110**, the second flange portion **121** of the rupture guide plate **120**, and the third flange portion **131** of the support plate **130** that configure the rupture disk **100** may be pressure-welded and coupled to one another at a plurality of positions in the circumferential direction. The thin dome plate **110**, the rupture guide plate **120**, and the support plate **130** are configured integrally with one another by the pressure-welding, and the convex portions of the first dome-shaped portion **112** and the second dome-shaped portion **122** are fastened to the object **101** so as to be directed toward the inner portion of the gas insulated switchgear. Therefore, the air-tightness of the SF₆ gas is maintained by the thin dome plate **110**, and an internal pressure of a set value or less is maintained by the rupture guide plate **120** and the support plate **130**.

When a pressure of the gas insulated switchgear exceeds an appropriate pressure in a state in which the rupture disk **100** is mounted, the first dome-shaped portion **112** of the thin dome plate **110** and the second dome-shaped portion **122** of the rupture guide plate **120** are instantaneously deformed in a reverse direction, and the rupture bridge **126** is first ruptured at a limitation pressure, such that the flap dome **122b** of the rupture guide plate **120** suddenly sinks (open). In this case, since the support dome **122a** of the rupture guide plate **120** is fixed, the thin dome plate **110** is cut in the same shape as that of the sawtooth outer profile **125b** by a punch action generated by a gas pressure.

FIG. 5 is an exploded perspective view of a rupture disk **200** according to a second exemplary embodiment of the present invention.

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The rupture disk **200** according to the present embodiment includes only a thin dome plate **210** and a rupture guide plate **220**. In the case in which a stable structure may be maintained only with the rupture guide plate **220** according to a pressure degree, the rupture disk is completed only with a laminate of the thin dome plate **210** and the rupture guide plate **220** without the support plate **130** described above. Other components will be denoted by reference numerals similar to those of the first exemplary embodiment, and a description thereof will be replaced by the description in the first exemplary embodiment. Also in exemplary embodiments to be described below, a detailed description of components denoted by reference numerals similar to those of the first exemplary embodiment will be omitted.

FIG. **6** is an exploded perspective view of a rupture disk **300** according to a third exemplary embodiment of the present invention.

The rupture disk **300** according to the present embodiment includes a thin dome plate **310**, a rupture guide plate **320**, and a support plate **330**, but has a structure in which the support plate **330** is directly laminated on the rupture guide plate **320**, unlike the first exemplary embodiment. In addition, according to a structure or a shape of a mounting portion of the gas insulated switchgear that has been already designed, the fastening holes or the protrusion portions may also be omitted in the present embodiment.

FIG. **7** is an exploded perspective view of a rupture disk **400** according to a fourth exemplary embodiment of the present invention.

The rupture disk **400** according to the present embodiment also includes a thin dome plate **410**, a rupture guide plate **420**, and a support plate **430**, and has a structure in which the support plate **430** is directly laminated on the rupture guide plate **420**. On the other hand, in the present embodiment, the support plate **430** is provided with an open type support **432**, unlike the third exemplary embodiment. The open type support **432** supports a support dome **422b** of the rupture guide plate **420** so as not to be deformed due to a gas pressure and allows a punch action to be appropriately performed.

FIG. **8** is an exploded perspective view of a rupture disk **500** according to a fifth exemplary embodiment of the present invention.

The rupture disk **500** according to the present embodiment includes a thin dome plate **510**, a rupture guide plate **520**, a first support plate **530**, and a second support plate **540**. The first support plate **530** may be provided with an open type support **532**. The second support plate **530** includes a fourth flange portion **541** and has an open hole **H2** formed at the center thereof.

The disposition of the support plates **530** and **540** as described above allows the thin dome plate **510** to be accurately ruptured in a set pressure range at the time of rupture and increases reliability.

FIG. **9** is an exploded perspective view of a rupture disk **600** according to a sixth exemplary embodiment of the present invention.

The rupture disk **600** according to the present embodiment includes a thin dome plate **610**, a rupture guide plate **620**, and a support plate **630**. Here, in the rupture disk **600** according to the present embodiment, shapes of a slot **625**, a sawtooth outer profile **625b** configuring the slot **625**, a connection slot **625d**, and a protrusion portion **629** are slightly different from those of the rupture disk according to the first exemplary embodiment. Also in the rupture disk **600** according to the present embodiment, a rupture bridge **626** is positioned at an outer vortex **625c** of the sawtooth outer profile **625b**.

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FIG. **10** is an exploded perspective view of a rupture disk **700** according to a seventh exemplary embodiment of the present invention.

The rupture disk **700** according to the present embodiment includes a thin dome plate **710**, a rupture guide plate **720**, and a support plate **730**. A slot **725** is formed in a line shape. Therefore, both of the inner profile and the outer profile are formed in a sawtooth shape.

FIG. **11** is a plan view showing one form of a rupture guide plate that may be used in the rupture disk according to the present invention.

In the present example, the rupture guide plate **820** includes five slots **825A**, **825B**, **825C**, **825D**, and **825E** connected to one another by four rupture bridges **826**. A rupture restriction opening **827** and a hinge portion **828** are formed between the slots **825A** and **825E** disposed at edges. Each of the slots **825A**, **825B**, **825C**, **825D**, and **825E** includes a sawtooth outer profile and an arc inner profile defining a rupture shape of the thin dome plate, and the rupture bridge **826** is positioned at an outer vortex of the sawtooth outer profile. The sawtooth outer profile may have seven sawteeth. In order to facilitate installation, the rupture guide plate **820** may be provided with fastening holes **823**, and an edge of the flange portion **821** may be provided with a protrusion portion **824** to which a tag is attached.

FIG. **12** is a plan view showing another form of a rupture guide plate that may be used in the rupture disk according to the present invention.

In the present example, the rupture guide plate **920** includes four slots **925** connected to one another by three rupture bridges **926**. Also in the present example, the rupture bridge **926** is positioned at an outer vortex of a sawtooth outer profile. However, the sawtooth outer profile has five sawteeth.

FIG. **13** is a plan view showing still another form of a rupture guide plate that may be used in the rupture disk according to the present invention.

In the present example, the rupture guide plate **1020** includes five slots **1025** connected to one another by four rupture bridges **1026**. Also in the present example, the rupture bridge **926** is positioned at an outer vortex of a sawtooth outer profile. However, the sawtooth outer profile has seven sawteeth.

FIGS. **14A** to **14D** are plan views showing various patterns of a slot that may be formed in the rupture guide plate according to the present invention.

FIG. **14A** shows a slot **1125** formed in a line shape, and FIG. **14B** shows a slot **1125** in which both of the inner profile and the outer profile are formed in a sawtooth shape and are spaced apart from each other by a predetermined gap. A slot **1325** shown in FIG. **14C** has a sawtooth outer profile and a geometric inner profile including arc or oval patterns. A slot **1425** shown in FIG. **14D** has a sawtooth outer profile and an arc inner profile. These slots may be selectively used in connection with a thickness of the used thin dome plate, a thickness of the used rupture guide plate, a set rupture pressure, or the like, or may be used in combination on one rupture guide plate. A size of a design slot and the number of sawteeth in the design slot are associated with the number of rupture bridges and a rupture pressure. Generally, when the number of rupture bridges increases, the number of sawteeth decreases.

FIGS. **15A** to **15D** are plan views showing various connection patterns between adjacent slots that may be formed in the rupture guide plate according to the present invention.

As shown in FIG. **15A**, slots **1525** having a line shape may be connected to each other by a rupture bridge **1526** having only a predetermined distance. FIG. **15B** shows that a rupture bridge **1626** is positioned at an inner vortex portion of a

sawtooth outer profile in a slot **1626** having an arc inner profile and the sawtooth outer profile. In a slot **1725** shown FIG. **15C**, a sawtooth outer profile has a straight line or arc section in order to form a rupture bridge **1726**. The rupture bridge **1726** has a wide width at an inner side thereof and a narrow width at an outer side thereof. On the other hand, a rupture bridge **1826** of FIG. **15D** has a narrow width at an inner side thereof and a wide width at an outer side thereof. These rupture bridges may be selectively used in connection with a thickness and a material of the used thin dome plate, a thickness and a material of the used rupture guide plate, a set rupture pressure, or the like, or may be used in combination on one rupture guide plate.

FIGS. **16A** to **16D** are plan views showing various patterns of a hinge portion that may be formed in the rupture guide plate according to the present invention.

As shown in FIG. **16A**, two rupture restriction openings **1927** having a large hole shape are formed and a hinge portion **1928** is formed by the two rupture restriction openings **1927** so that the rupture guide plate may be easily hinged when it is ruptured. A slot **1925** and the rupture restriction opening **1927** are not connected to each other, but have a rupture bridge **1926** formed therebetween, wherein the rupture bridge serves as a second hinge. In FIG. **16B**, a rupture restriction opening **2027** having a small rectangular shape is formed, and the rupture restriction opening **2027** and a slot **2025** are connected to each other in a line shape. In FIG. **16C**, a rupture restriction opening **2127** having a small rectangular shape is formed, and the rupture restriction opening **2127** and a slot **2125** are connected to each other in a poly-line shape. In FIG. **16D**, a rupture restriction opening **2227** having a small rectangular shape is formed, and the rupture restriction opening **2227** and a slot **2225** are also connected to each other in a poly-line shape. However, the slot **2225** connected to the rupture restriction opening **2227** separately includes a rupture bridge **2226**.

FIG. **17** is a perspective view showing a state in which a rupture disk **2300** according to an eighth exemplary embodiment of the present invention is assembled; and FIG. **18** is an exploded perspective view showing a laminated state of the rupture disk **2300** of FIG. **17**. As shown in FIGS. **17** and **18**, the rupture disk **2300** has a form in which a plurality of plates are laminated. More specifically, the rupture disk **2300** includes a thin dome plate **2310**, a rupture guide plate **2320**, and a thin protecting plate **2330**. These plates are laminated as shown in FIG. **18** to have an assembly form as shown in FIG. **17**.

Referring to FIG. **18**, the rupture disk according to the present embodiment may include a flexible sealing layer **2340** disposed between a first flange portion **2311** and a third flange portion **2331** or between a first dome-shaped portion **2312** and an open dome-shaped protecting surface **2332**. The flexible sealing layer **2340**, which is formed so as to maintain air-tightness between the first flange portion **2311** and the third flange portion **2331** or between the first dome-shaped portion **2312** and the open dome-shaped protecting surface **2332**, blocks a sand or a foreign material from penetrating into a gap between the thin dome plate **2310** and the thin protecting plate **2330**. In the case in which the sand or the foreign materials is inserted, durability or a rupture pressure of the thin dome plate **2310** may be affected, which is prevented in advance by the flexible sealing layer **2340**.

The flexible sealing layer **2340**, which is made of a silicone resin or a silicone rubber, may be obtained by applying and curing the silicone resin or the silicone rubber to a target region. A masking member may be used in a manufacturing process so that the silicone resin or the silicone rubber is

prevented from being leaked and is applied only to a predetermined region when it is applied. As the masking member, a release film or a release agent may be used.

FIG. **19** is an exploded perspective view of a rupture disk **2400** according to a ninth exemplary embodiment of the present invention.

The rupture disk **2400** according to the present embodiment further includes a foreign material blocking layer **2450**, in addition to a thin dome plate **2410**, a rupture guide plate **2420**, a thin protecting plate **2430**, and a flexible sealing layer **2440**. The foreign material blocking layer **2450**, which blocks a sand or a foreign material from penetrating into a slot **2425**, a rupture restriction opening **2426**, or the like, which is a portion exposed to the outside during handling, is made of a silicone resin or a silicone rubber, similar to the flexible sealing layer **2440**. FIG. **19** shows that the foreign material blocking layer **2450** is formed at an inner side of the rupture guide plate **2420**, more specifically, an inner side of a second dome-shaped portion **2422** of the rupture guide plate **2420**. The foreign blocking layer **2450** continuously maintains reliability of the rupture disk **2400** in a desert or an environment in which a large amount of dust is present.

FIG. **20** is an exploded perspective view of a rupture disk **2500** according to a tenth exemplary embodiment of the present invention.

In the rupture disk **2500** according to the present embodiment, a foreign material blocking layer **2550** is disposed between a thin dome plate **2510** and a rupture guide plate **2520**, unlike the foreign material blocking layer **2450** shown in FIG. **19**. The foreign blocking layer **2550** also continuously maintains reliability of the rupture disk **2500** in a desert or an environment in which a large amount of dust is present.

With the rupture disk and the gas insulated switchgear according to the exemplary embodiments of the present invention, when an internal pressure of an insulated gas filled in the apparatus suddenly increases, the thin dome plate is ruptured to discharge the insulated gas, thereby making it possible to prevent damage to a pressure container and minimize enlargement loss.

According to the exemplary embodiments of the present invention, the rupture disk is accurately ruptured in an error range of a set pressure, thereby making it possible to safely discharge the SF₆ gas.

In the rupture disk and the insulated gas switchgear as described above, the configurations and the method according to the above-mentioned exemplary embodiments are not restrictively applied. All or some of the above-mentioned exemplary embodiments may also be selectively combined with each other so that various modifications may be made.

The invention claimed is:

1. A rupture disk for a gas insulated switchgear, the rupture disk comprising:

- a thin dome plate including a first flange portion and a first dome-shaped portion formed in a dome shape at the center of the first flange portion;
- a rupture guide plate laminated inside the first flange portion and the first dome-shaped portion and including a second flange portion laminated on the first flange portion and a second dome-shaped portion having a plurality of slots formed to define a rupture shape so that a part of the first dome-shaped portion is ruptured in a predetermined shape when an internal pressure increases;
- a thin protecting plate laminate outside the first flange portion and the first dome-shaped portion so as to protect the thin dome plate and including a third flange portion laminated on the first flange portion and an open dome-

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shaped protecting surface protecting an outer portion of the first dome-shaped portion; and
 a foreign material blocking layer disposed on an inner side of the second dome-shaped portion or between the thin dome plate and the rupture guide plate, and the foreign material blocking layer being configured to block sand or foreign material from penetrating into the plurality of the slots.

2. The rupture disk of claim 1, further comprising a flexible sealing layer disposed between the first flange portion and the third flange portion or between the first dome-shaped portion and the open dome-shaped protecting surface and formed so as to maintain air-tightness between the first flange portion and the third flange portion or between the first dome-shaped portion and the open dome-shaped protecting surface.

3. The rupture disk of claim 2, wherein the flexible sealing layer is made of a silicone resin or a silicone rubber.

4. A gas insulated switchgear including the rupture disk of claim 1.

5. The rupture disk of claim 1, wherein each of the plurality of slots includes an arc inner profile and a sawtooth outer profile, the sawtooth outer profile includes inner vortexes and outer vortexes that are arranged alternately, and the slots adjacent one another are connected to one another by a rupture bridge at an outer vortex of the sawtooth outer profile.

6. The rupture disk of claim 1, further comprising a support plate including a fourth flange portion laminated on the second flange portion, and the fourth flange portion has an open type support formed, at a center portion thereof, in order to support an edge portion of the second dome-shaped portion.

7. The rupture disk of claim 1, wherein the thin dome plate further includes a first protrusion portion protruding at at least one portion of the first flange portion in a radial direction, and the rupture guide plate further includes a second protrusion

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portion protruding at a position corresponding to that of the first protrusion portion in the radial direction.

8. The rupture disk of claim 1, wherein each of the first flange portion and the second flange portion is provided with a plurality of fastening holes which are formed in a circumferential direction through and through which fastening bolts pass.

9. The rupture disk of claim 1, wherein the first flange portion and the second flange portion are pressure-welded and coupled to one another at a plurality of positions adjacent a circumferential of the rupture disk.

10. The rupture disk of claim 1, wherein each of the plurality of slots includes an inner profile and an outer profile, the inner profile including arc or oval patterns that are arranged at predetermined interval, and the outer profile including sawtooth patterns that are repeatedly arranged.

11. The rupture disk of claim 1, wherein the plurality of slots are formed in a sawtooth line shape, and adjacent slots among the plurality of slots are formed so as to have a predetermined interval therebetween to form a rupture bridge.

12. The rupture disk of claim 1, wherein end portions of slots disposed at both edges among the plurality of slots are provided with rupture restriction openings, respectively, to configure a hinge portion of the second dome-shaped portion; and

wherein a connection slot connects the slot and the rupture restriction opening with one another.

13. The rupture disk of claim 6, wherein end portions of slots disposed at both edges among the plurality of slots are provided with rupture restriction openings, respectively, to configure a hinge portion of the second dome-shaped portion; and

wherein a connection slot connects the slot and the rupture restriction opening with one another.

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